

REMARKS

Claims 1-20 are pending, with claims 1, 4, 13, 15, 17, and 19 being independent. Claims 1-8, 11, 13-15, 17, and 19 have been amended. No new matter has been added.

Claim Rejections Under 35 U.S.C. § 102(b)

Claims 1, 5, 6, 10, 11, and 17 stand rejected under 35 U.S.C. § 102(b) over U.S. Patent Application Publication No. 2003/0039597 ("Deeba"). This rejection is respectfully traversed.

The present invention relates to an exhaust gas purification apparatus for an internal combustion engine provided with a sulfur oxidation catalyst, a sulfur trapping agent and a NO_x trapping catalyst. The presently claimed sulfur trapping agent does not substantially release trapped sulfur or releases sulfur in a very small amount.

In particular, the presently claimed sulfur trapping agent contains at least one alkali or alkaline earth metal and at least one noble metal (*e.g.*, Pt, Pd or Rh) in an amount of 0.4 % by weight or less of the sulfur trapping agent. If the amount of noble metal is greater than 0.4 % by weight, trapped sulfur is released into the atmosphere, which is harmful to the environment. (See, for example, Page 13, Lines 6-20, of the Present Specification).

The presently claimed sulfur trapping agent does not need a desulfurization treatment; as the amount of noble metal is 0.4% by weight or less, trapped SO_x is not released when an air fuel ratio of the exhaust gas is rich. (See, for example, Page 13, Lines 12-20, of the Present Specification). The presently claimed amount of noble metal of 0.4% by weight or less is essential for preventing the release of SO_x during the operation of an engine. As explained in the present specification, "the sulfur trapping agent does not desorb (or does not substantially release) at the time of rich or stoichiometric air fuel ratio" (page 5, lines 12-14), wherein, "The words 'does not desorb' are used to mean that a damaging amount of sulfur components are not released" (page 5, lines 17-18).

Accordingly, amended independent claim 1 recites an exhaust gas purification apparatus disposed in an exhaust gas passage of an internal combustion engine having a NOx purification catalyst, which comprises a sulfur component trapping agent for trapping sulfur components, which is arranged before the NOx trapping catalyst and a catalyst for oxidizing the sulfur components, disposed before the sulfur component trapping agent that contains at least one alkali or alkaline earth metal and at least one noble metal in an amount of 0.4 % by weight or less of the sulfur trapping agent, wherein the sulfur component trapping agent does not substantially release the trapped sulfur components under the conditions of the internal combustion engine.

Similarly, amended independent claim 17 recites a method of purification of an exhaust gas for an internal combustion engine, which comprises oxidizing sulfur components in the exhaust gas, trapping and accumulating the sulfur components in a sulfur component trapping agent, and purifying NOx in the exhaust gas with a NOx purifying catalyst, the sulfur component trapping agent containing at least one alkali or alkaline earth metal and at least one noble metal in an amount of 0.4 % by weight or less of the sulfur trapping agent.

In contrast, Deeba discloses a catalyst for removal of NOx and SOx from a gaseous stream containing SOx. In Deeba, a close coupled catalyst composite is located upstream of the gaseous stream. The close coupled catalyst composite comprises a first support, a first platinum group component and a SOx sorbent component selected from Ba, La, Mg, Mn, Nd, Pr, and Sr.

Applicants respectfully submit that desulfurization is essential in Deeba. (See, for example, paragraphs [0046], [0091] (specifically lines 19-22), [0110], [0112], [0124], and [0133] and Claim 19, of Deeba). Deeba does not disclose or suggest the SOx trap being free from desulfurization.

In Deeba, trapped SOx is released into the atmosphere by elevating a temperature of the gaseous stream to 550°C or higher. The high temperature is achieved by switching the operation of an engine to a rich or stoichiometric operation.

Deeba does not disclose or suggest an exhaust gas purification apparatus disposed in an exhaust gas passage of an internal combustion engine having a NOx purification catalyst, as recited in amended independent claim 1, or a method of purification of an exhaust gas for an internal combustion engine, as recited in amended independent claim 17, each comprising, *inter alia*, a sulfur trapping agent containing at least one alkali or alkaline earth metal and ***at least one noble metal in an amount of 0.4 % by weight or less of the sulfur trapping agent.***

Accordingly, withdrawal of the rejection of claims 1, 5, 6, 10, 11, and 17 stand rejected under 35 U.S.C. § 102(b) over Deeba is respectfully requested.

Claim Rejections Under 35 U.S.C. § 103(a)

- I -

Claims 2-4, 9, 13-16, and 18 stand rejected under 35 U.S.C. § 103(a) over Deeba. This rejection is respectfully traversed.

Amended independent claim 4 recites an exhaust gas purification apparatus for an internal combustion engine, which comprises a NOx trapping catalyst for trapping NOx, which is disposed in an exhaust gas passage, a sulfur component trapping agent disposed before the NOx trapping catalyst for trapping sulfur components, and a catalyst disposed before the sulfur component trapping agent for oxidizing the sulfur components, wherein the sulfur component trapping agent contains at least one of alkali metals and alkaline earth metals and a total amount of Pt, Pd and Rh is at least 0.4 % by weight or less of the sulfur component trapping agent.

Amended independent claim 13 recites a sulfur component trapping agent for trapping sulfur components in an exhaust gas, which contains at least one alkali or alkaline earth metal and at least one noble metal in an amount of 0.4 % by weight or less of the sulfur trapping agent, wherein the sulfur component trapping agent has a trapping rate of 85 % or more of an amount of inflow sulfur in a trapping test at a flow rate of 150 ppm SO₃ - 5% O₂ – balance being N₂ gas

per 1.5 moles of the sulfur trapping agent at 300 °C and a space velocity of 30,000/h for 1 hour; and the sulfur component trapping agent has a release rate of sulfur amount of 5 % or less of sulfur trapped in the sulfur component trapping agent in a release test under a flow of a 3000 ppm H₂ – 600 ppm C₃H₆ – 3000 ppm O₂ – 3.5 % CO – balance being N₂ gas at a temperature elevation rate of 10 °C /min from 250 to 750 °C at an sulfur component trapping agent entrance, after the trapping test.

Amended independent claim 15 recites a sulfur component trapping agent for trapping sulfur in an exhaust gas, which comprises a honeycomb substrate made of cordierite or metal, a porous support, and a sulfur trapping agent supported on the porous support, wherein the sulfur trapping agent contains 1 to 4 moles of at least one of alkali metals and alkaline earth metals in (molar number of alkali metals /2 + molar number of alkaline earth metals) as conversion of elements, and the total amount of Pt + Pd + Rh is 0.4 % by weight or less per the sulfur component agent.

As discussed above, Deeba does not disclose or suggest a sulfur trapping agent that does not release SO_x during the operation of an ending and which does not need a desulfurization treatment.

In particular, Deeba does not disclose or suggest an exhaust gas purification apparatus for an internal combustion engine, as recited in amended independent claim 4, a sulfur component trapping agent, as recited in amended independent claim 13, or a sulfur component trapping agent for trapping sulfur in an exhaust gas, as recited in amended independent claim 15, each comprising, *inter alia*, a sulfur component trapping agent containing at least one of alkali metals and alkaline earth metals and ***at least one noble metal (e.g., Pt, Pd and Rh) in an amount of 0.4 % by weight or less of the sulfur trapping agent.***

Accordingly, withdrawal of the rejection of claims 2-4, 9, 13-16, and 18 stand rejected under 35 U.S.C. § 103(a) over Deeba is respectfully requested.

- II -

Claims 7 and 8 stand rejected under 35 U.S.C. § 103(a) over Deeba in view of U.S. Patent Application Publication No. 2002/0053202 ("Akama"). This rejection is respectfully traversed.

Akama, cited by the Office Action merely for disclosure "that it is conventional to utilize catalyzed filters in exhaust treatment devices", does not cure the above-noted deficiencies with regard to Deeba. In particular, the proposed combination of Deeba and Akama does not disclose or suggest an exhaust gas purification apparatus disposed in an exhaust gas passage of an internal combustion engine having a NOx purification catalyst comprising, *inter alia*, a sulfur trapping agent containing at least one alkali or alkaline earth metal and ***at least one noble metal in an amount of 0.4 % by weight or less of the sulfur trapping agent.***

Accordingly, withdrawal of the rejection of claims 7 and 8 stand rejected under 35 U.S.C. § 103(a) over Deeba in view of Akama is respectfully requested.

- III -

Claim 12 stands rejected under 35 U.S.C. § 103(a) over Deeba in view of U.S. Patent Application Publication No. 2007/0183952 ("Jordan"). This rejection is respectfully traversed.

Jordan, cited by the Office Action merely for disclosure "that it is conventional in the art to employ replaceable sulfur trapping agents in exhaust treatment apparatuses", does not cure the above-noted deficiencies with regard to Deeba. In particular, the proposed combination of Deeba and Jordan does not disclose or suggest an exhaust gas purification apparatus disposed in an exhaust gas passage of an internal combustion engine having a NOx purification catalyst comprising, *inter alia*, a sulfur trapping agent containing at least one alkali or alkaline earth metal and ***at least one noble metal in an amount of 0.4 % by weight or less of the sulfur trapping agent.***

Accordingly, withdrawal of the rejection of claim 12 stands rejected under 35 U.S.C. § 103(a) over Deeba in view of Jordan is respectfully requested.

- IV -

Claims 19 and 20 stand rejected under 35 U.S.C. § 103(a) over U.S. Patent Application Publication No. 2003/0010020 ("Taga") in view of U.S. Patent No. 6,263,666 ("Kubo"). This rejection is respectfully traversed.

Amended independent claim 19 recites a method of diagnosis of degradation of a sulfur component trapping agent in an exhaust gas purification apparatus comprising a NOx purification catalyst, a sulfur component trapping agent disposed before the NOx purification catalyst, and a sulfur component oxidizing catalyst disposed before the sulfur component trapping agent, which comprises measuring NOx purification rates before and after a step of releasing a sulfur component from the NOx purification catalyst and diagnosing a degradation of the sulfur component trapping agent based on a difference or ratio of the NOx purification rates, the sulfur trapping agent containing at least one alkali or alkaline earth metal and at least one noble metal in an amount of 0.4 % by weight or less of the sulfur trapping agent.

Taga discloses an exhaust gas purifying apparatus comprising a control unit (29) operative to estimate an amount of NOx absorbed by a NOx trap material (17) disposed in an exhaust passage (10) and to make an air-fuel ratio richer so as thereby to cause the NOx trap material to release sulfur when the estimated amount of NOx absorption exceeds a specified amount. (Abstract). Kubo is cited by the Office Action merely "to demonstrate that it is conventional in the art to include an indicating means to indicate when an aftertreatment device is degraded".

Applicants respectfully submit that the proposed combination of Taga and Kubo does not disclose or suggest, at least, a sulfur trapping agent containing at least one alkali or alkaline earth metal and at least one noble metal in an amount of 0.4 % by weight or less of the sulfur trapping agent, as recited in amended independent claim 19.

Accordingly, withdrawal of the rejection of claims 19 and 20 stand rejected under 35 U.S.C. § 103(a) over Taga in view of Kubo is respectfully requested.

Conclusion

If there are any questions regarding this amendment or the application in general, a telephone call to the undersigned would be appreciated since this should expedite the prosecution of the application for all concerned.

If necessary to effect a timely response, this paper should be considered as a petition for an Extension of Time sufficient to effect a timely response, and please charge any deficiency in fees or credit any overpayments to Deposit Account No. 05-1323 (Docket #102147.58294US).

March 23, 2009

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